

# Modeling and Simulation in Robotics Workshop

Breakout Summary Slides

Team 2

Breakout 1

# Slide 1: Consensus Thinking

- Develop in pure simulation, never touch real world
  - Can drop into real world and we know that it works
  - Rapid prototyping, tie a robotic simulator into e.g. a SolidWorks pipeline
  - Simulator validation is important aspect
  - Risk assessment, establish safety protocols within simulator
- Dream for human simulation
  - Realistic people in the simulator, important when studying human/robot interaction
    - Not just crowd simulator, but people actually doing tasks, including manipulation and cognitive models of people
    - Learn how to co-operate with people on tasks, especially on physically co-operative tasks
- Post-deployment integration
  - Capture emergent behavior of systems, tune emergent behaviors
  - Simulation play role for standardization, ex. Autonomous cars from many vendors
  - Certified libraries (from, e.g. government lab or industry standards body)
- Procedural content creation and randomization
  - Some work in the city planning community
- Human-in-the-loop simulation
  - Demonstrating how to perform things
  - Acting as adversary trying to break
  - Create and get reactions to rare/critical events
  - Mechanical turk for robot training – difficulties with hardware and internet speeds
- But the “virtuality gap” is real
  - You may not elicit the same responses from people when they know it’s not real

# Slide 2: “Somewhat contentious” Ideas

- Need a Grand Unified Simulator
  - Interactions between many seemingly disjoint facets of the problem (perception, humans, deformable objects)
  - Capture uncertainty and, importantly, uncertainty of interactions between facets of the problem (e.g. multi-scale modeling)
  - Standardized environment/scenario set that are “sufficient” for covering the space of real world problems
  - 1000x real-time, enables many important applications (e.g. incorporate as part of control loop)
  - Simulator that you can dial back the complexity
  - Publically available simulators with deformable and soft surfaces
- Don’t need a Grand Unified Simulator
  - Impractical
    - Too many technologies into one place
    - Scalability
    - Radically different domains (combustion in engine, traffic in city)
  - Unnecessary
    - Actually just need mechanisms to transfer knowledge between simulators
    - You need to balance between tasks that need high fidelity and tasks that don’t
      - Controls: you just need to capture rough impact of decisions,
      - Perception: you need photo-realistic simulation?
- Design of experiment
  - Shorten the design loop for experiments, esp. in human experiments
  - Take derivatives of simulator (for controls point of view)
  - Understand structures of the problem

## Slide 3: Odds and ends, out there thoughts, fun stuff

- Digital twin – important concept in industrial/manufacturing applications
- Authoring tools – game community is really good for this
- Risk assessment

# Cheat Sheet Slide

- Breakout Themes, “M&S in Robotics” workshop:
  - Breakout 1: Panoramic view of opportunities  
[a time to dream]
  - Breakout 2: What’s stopping us from getting there  
[the reality check]
  - Breakout 3: Pragmatic suggestions for moving forward  
[what funding organizations, the robotics community,  
or other vested parties can/should do]

- Breakout session, things to keep in mind
  - You have 25 mins to generate your three slides
  - Select a scribe to generate your three slides
  - Decide who will present your slides in plenary
  - Do not argue within team for more than 2 mins about an idea. Move it to “Slide 2” and proceed
  - Generate diverse/original/out-there ideas
- Plenary session, things to keep in mind
  - Each team has 5 mins to present its slides
  - We seek to collect as many original ideas/points of view/opinions as possible
    - Settling contentious issues not a priority
  - Use open-floor discussion to add to what the teams have presented
  - Limit your remarks to one to two minutes. Give others an opportunity to speak. Keep it fun, keep it friendly